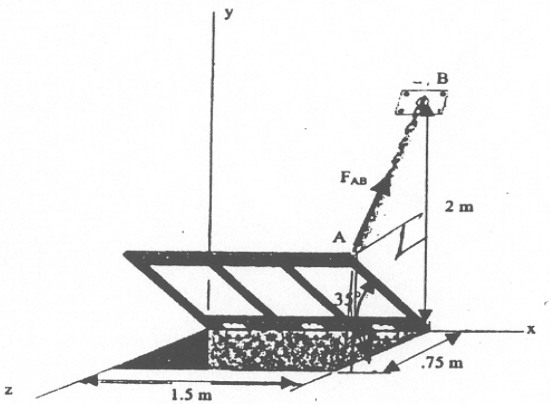
1) Force F_{AB}, acting along the chain AB, has a magnitude of 100.0 N. You may recall that any force can be represented by perpendicular and parallel components.
   a) Express F_{AB} as a Cartesian vector.
   b) For a perpendicular component $F_{\perp} = (-32.34i + 17.67j + 6.671k)$ N, calculate:
      i) the magnitude of the parallel component, $F_{//}$
      ii) the vector representation of the parallel component, $F_{//}$
   c) What is the angle between the perpendicular component and force F_{AB}.



a) forces?

$\tan 35 = \frac{opp}{adj}$

$\tan 35 (0.75m) = 0.525m$

b) i) $\vec{A} = \vec{A}_{//} + \vec{A}_{\perp}$

$\vec{A}_{//} = \vec{A} - \vec{A}_{\perp}$

$B = (0m\hat{i} + 1.5m\hat{j} + 2m\hat{k})$

$A = (0.75m\hat{i} + 1.5m\hat{j} + 0.525m\hat{k})$

$\overrightarrow{AB} = (-0.75m\hat{i} + 0m\hat{j} + 1.475m\hat{k})$

(45.3N + 32.34N)$\hat{i}$

(0N − 17.67N)$\hat{j}$

(89.1N − 6.671N)$\hat{k}$

3

(12.96N$\hat{i}$ − 17.67N$\hat{j}$ + 82.40N$\hat{k}$)

method?

$u_{AB} = \frac{(-0.75m\hat{i} + 0m\hat{j} + 1.475m\hat{k})}{1.655m}$

$= -0.453\hat{i} + 0\hat{j} + 0.891\hat{k}$

$\sqrt{(-12.96N\hat{i})^2 + (-17.67N\hat{j})^2 + (82.4N\hat{k})^2}$

85.3N 3

$F_{AB} = F\, u_{AB}$ 2

$= (100N)(-0.453\hat{i} + 0\hat{j} + 0.891\hat{k})$

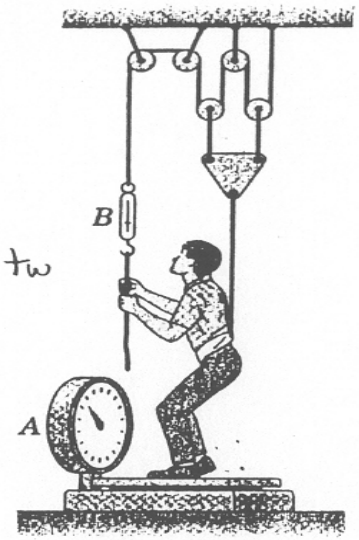
$\vec{F}_{AB} = -45.3N\hat{i} + 0N\hat{j} + 89.1N\hat{k}$

$(-12.96N\hat{i} - 17.67N\hat{j} + 82.4N\hat{k})$

c) $\theta = \arccos\left(\frac{\vec{F}_{\perp} \cdot \vec{F}_{AB}}{F_{\perp} F_{AB}}\right) = \frac{(-32.34\hat{i} + 17.67\hat{j} + 6.671\hat{k})N \cdot (-45.3N\hat{i} + 0N\hat{j} + 89.1N\hat{k})}{(37.45N)(100N)}$

5 $= \frac{1465N^2 + 594.39N^2}{3745.0N^2} = 56.64°$

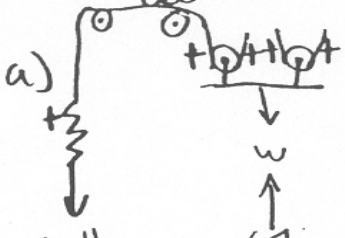
2) A former student of mechanics wishes to weigh himself but has access only to a scale (A) with a capacity of 100 lb and a small spring scale (B) with a capacity of 20 lb. With the pulley system shown below he discovers that when he exerts a pull on the rope so that B registers 19 lb., the scale A reads 67 lb.
   a) What is his correct weight? Be sure to present clear Free Body Diagrams to support your answer.
   b) Calculate the stretch in the spring scale at B for a spring constant k = 10 lb/in.



67lb + w = tw

FBD

a)



4t = w

4(19) = 76lb

67lb + 76lb = tw = ~~143~~ 143 lb

b)

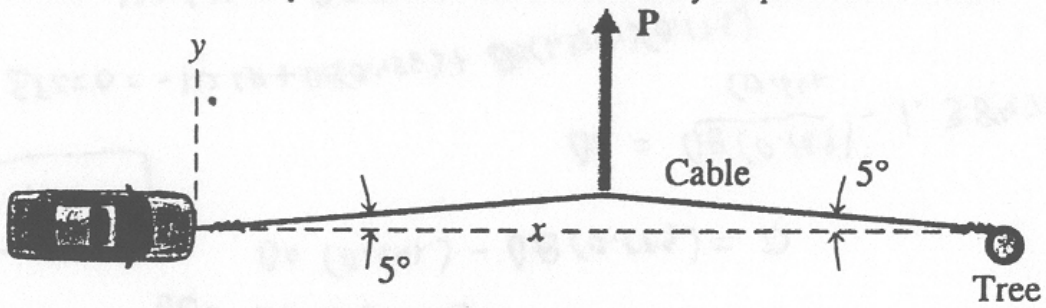
F = kS ✓

~~143~~ lb = 10lb/in (S)

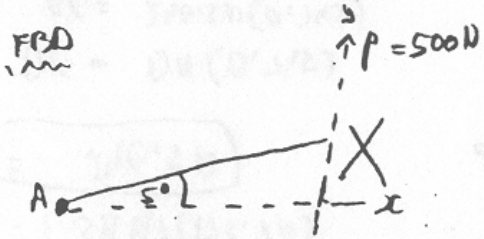
14.3 in = S

2

3) An automobile stuck in a muddy field is being moved by using a cable fastened to a tree as shown in the figure below. When the cable is in the position shown and force P = 500 N, determine the x and y components of the cable force being applied to the automobile. Be sure to provide a clear FBD and the x and y components of the force.



FBD



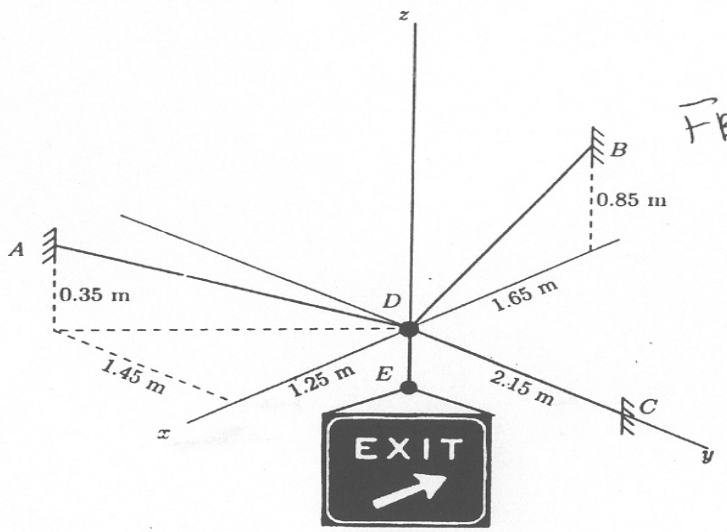
01

$F_y = 500\,N$

$\tan\theta = \frac{opp}{adj}$

$adj = \frac{opp}{\tan\theta} = \frac{500N}{\tan 5} = 15.0\,N$

4) The 12.5-kg road sign is supported by cables DA, DB, DC, and DE. Determine the force acting in each cable for equilibrium.



FBD?

1.856

1.945

$W = F = mg = 12.5\,kg\,(9.81\,m/s^2) = 122.6\,N$

show work/method

$\Sigma \vec{F} = 0$

$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma F_z = 0$

how?

$\Sigma F_x = -DB\,(0.889) + \ldots$

$D_A\,(0.642)$

$\Sigma F_y = -D_A(0.745) + DC$

$\Sigma F_z = -122.6N + DB(0.458) + DA(0.171)$

$D_A = 1.3847\,(173.7N)$

$D_A = 240.5\,N$

$DE = 122.6\,N$

$DC - D_A(0.745)$

$DC = 240.5N(0.745)$

$D_A\,(0.642) - DB\,(0.889) = 0$

$DC = 179.2N$

$D_A = \frac{DB\,(0.889)}{(0.642)} = 1.3847\,DB$

$\Sigma F_z = 0 = -122.6N + DB(0.458) + DB(1.3847)(0.171)$

$122.6N = DB\,(0.458) + DB\,(0.248)$

$122.6N = DB\,(0.706)$

$173.7N = DB$